WATER SUPPLY OUTLOOK FOR WESTERN UNITED STATES

Including Columbia River Drainage in Canada

and

FEDERAL - STATE - PRIVATE COOPERATIVE SNOW SURVEYS

UNITED STATES DEPARTMENT of AGRICULTURE···SOIL CONSERVATION SERVICE
Collaborating with
CALIFORNIA DEPARTMENT of WATER RESOURCES
and
BRITISH COLUMBIA DEPARTMENT of
LANDS, FORESTS and WATER RESOURCES

AS OF
MAY 1, 1967

TO RECIPIENTS OF WATER SUPPLY OUTLOOK REPORTS:

Most of the usable water in western stotes originates as mountoin snowfall. This snowfall accumulates during the winter and spring, several months before the snow melts and appears as streamflow. Since the runoff from precipitation as snow is deloyed, estimates of snowmelt runoff can be made well in advance of its occurrence. Streamflow forecasts published in this report are based principally an measurement of the water equivalent of the mountain snowpack.

Forecasts become more accurate as more of the data affecting runoff are measured. All forecasts assume that climatic factors during the remainder of the snow accumulation and melt season as they affect runoff will add to be an effective average. Early season forecasts are therefore subject to a greater change than those made on later dates.

The snow course measurement is obtained by sampling snow depth and water equivalent at surveyed and marked locations in mountain areas. A total of about ten samples are taken at each location. The average of these are reparted as snow depth and water equivalent. These measurements are repeated in the same location near the same dates each year.

Snow surveys are made monthly or semi-monthly from January 1 through June 1 in most states. There are about 1400 snow courses in Western United States and in the Columbia Basin in British Columbia. In the near future, it is anticipated that automatic snow water equivalent sensing devices along with radio telemetry will provide a continuous record of snow water equivalent at key locotions.

Detailed data on snow course and soil moisture measurements are presented in state and local reports. Other data or reservoir storage, summaries of precipitation, current streomflow, ond soil moisture conditions at valley elevations are also included. The report for Western United States presents a broad picture of water supply outlook conditions, including selected streamflow forecasts, summary of snow accumulation to date, and staroge in larger reservoirs.

Snow survey and soil moisture data for the period of recard are published by the Soil Conservatian Service by states about every five years. Data for the current year is summarized in a West-wide basic data summary and published about October 1 of each year.

Listed below are water supply outlook reports based on Federal-State-Private Cooperative snow surveys. Those published by the Soil Conservation Service may be obtained from Soil Conservotion Service, Room 507, Federal Building, 701 N. W. Glisan, Portlond, Oregon 97209.

PUBLISHED BY SOIL CONSERVATION SERVICE

D. A. WILLIAMS, Administrator

The Soil Canservation Service publishes reports following the principal snow survey dates from January 1 through June 1 in cooperation with state water administrators, agricultural experiment stations and others. Capies of the reports for Western United States and all state reports may be obtained from Soil Conservation Service, Western Regional Technical Service Center, Room 507, 701 N. W. Glisan, Portland, Oregon 97209.

Copies of state and local reports may also be obtained from state offices of the Soil Conservation Service in the following states:

STATE	ADDRESS
Alaska	P. O. Box "F", Palmer, Alaska 99645
Arizona	6029 Federal Building, Phoenix, Arizona 85205
Colorado (N. Mex.)	12417 Federal Building, Denver, Colorado 80202
Idaho	P. O. Box 38, Boise, Idaho 83701
Montana	P. O. Box 855, Bozeman, Montana 59715
Nevada	P. O. Box 4850, Reno Nevada 89505
Oregon	1218 S. W. Washington St., Portland, Oregon 97205
Utah	4001 Federal Building, Salt Lake City, Utah 84111
Washington	840 Bon Marche Bldg., Spokane, Washington 99206
Wyoming	P. O. Box 340, Casper, Wyoming 82602

PUBLISHED BY OTHER AGENCIES

Water Supply Outlook reports prepored by other agencies include a report for California by the Water Supply Forecast and Snow Surveys Unit, California Department of Water Resources, P. O. Box 388, Sacramento, California 95802 --- and for British Columbia by the Department of Lands, Forests and Water Resources, Water Resources Service, Parliament Building, Victoria, British Columbia

USDA SCS PORTLAND, OREG 1966

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ISSUED

MAY 1, 1967

The Soil Conservation Service coordinates snow surveys conducted by its staff and many cooperators, including the Bureau of Reclamation, Corps of Engineers, Forest Service, National Park Service, Weather Bureau, Geological Survey, and other Federal Agencies, Departments of State Government, Irrigation Districts, Power Companies, and others.

The Department of Water Resources coordinates snow surveys in California.

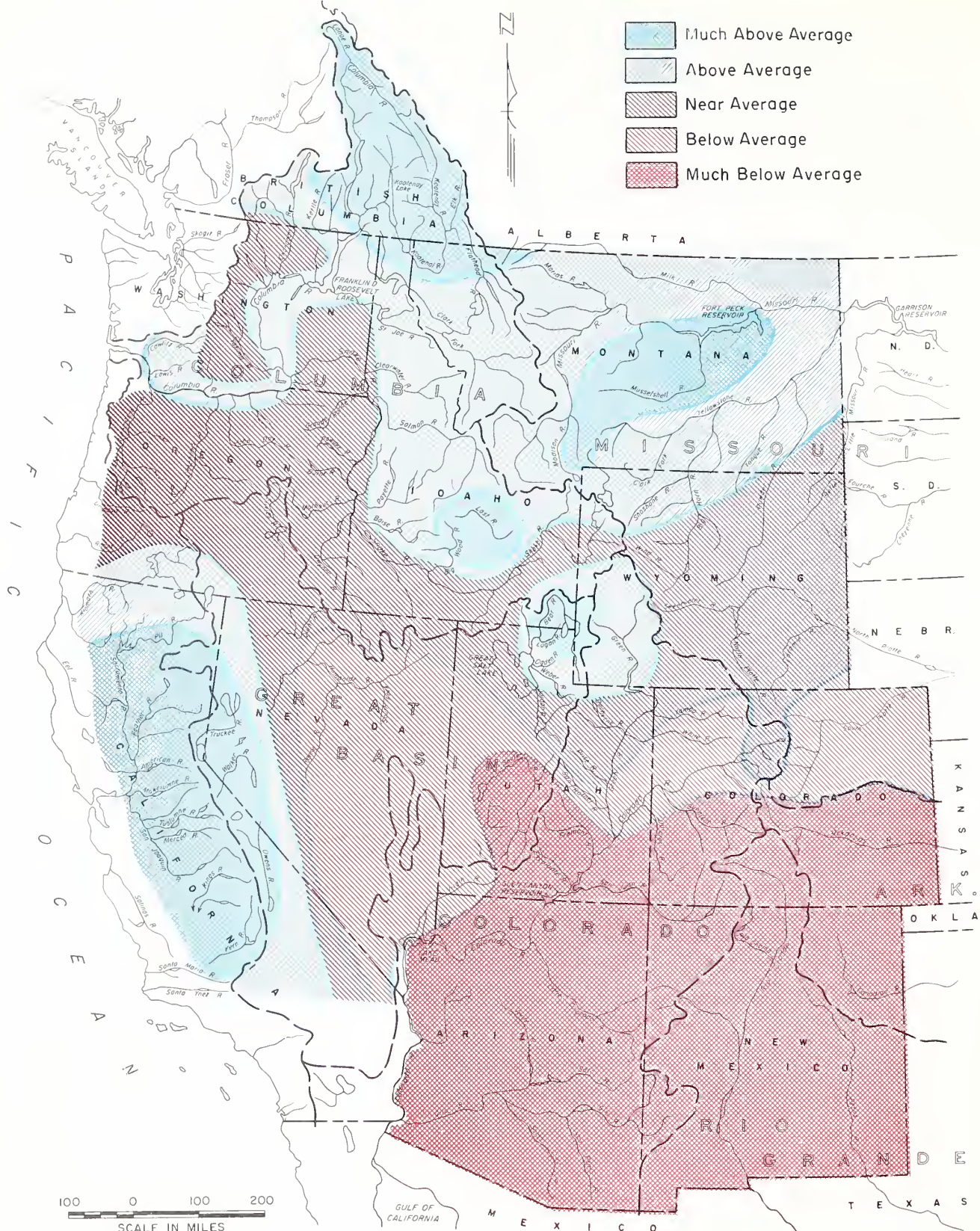
The Water Resources Service, Department of Lands, Forests, and Water Resources directs snow surveys in British Columbia.

This report was prepared by the Water Supply Forecasting Branch, Engineering Division, Soil Conservation Service, from data supplied by Snow Survey Supervisors of the Soil Conservation Service in the States of Alaska, Arizona, Colorado and New Mexico, Idaho, Montana, Nevada, Oregon, Utah, Washington, and Wyoming.

Data from California was supplied by the Chief, Water Supply Forecast and Snow Survey Unit, Department of Water Resources.

Data from British Columbia was supplied by the Chief, Hydrology Division, Water Investigations Branch, Department of Lands, Forests and Water Resources.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
D. A. WILLIAMS, ADMINISTRATOR



PROSPECTIVE STREAMFLOW

WATER SUPPLY OUTLOOK as of May 1, 1967

SNOWMELT SEASON FLOWS EXPECTED TO BE EXCESSIVE OVER UPPER COLUMBIA AND UPPER MISSOURI BASINS, AND FROM THE SIERRA RANGE IN CALIFORNIA. DEFICIENT STREAM FLOWS ARE IN PROSPECT FOR THE COLORADO, RIO GRANDE AND ARKANSAS BASINS. DELAY IN SNOWMELT IS SIGNIFICANT EXCEPT FOR THE MOUNTAINS OF ARIZONA AND NEW MEXICO.

Water supplies will be adequate for irrigation and power along most western mountain streams for 1967. Less than average flows are anticipated only in the southern Rocky Mountains and adjacent areas of southern Utah and Arizona. Shortages of water will be most severe on the Arkansas and Rio Grande.

Of more concern are excessive flows in prospect for the upper Columbia and upper Missouri basins as well as from the Sierras of California. A cool April has increased an already heavy snowpack to maximum or near maximum of record depending on elevation. The cool temperatures also delayed snowmelt. This will tend to concentrate streamflow from snowmelt into a shorter period and increases the probability of high river stages. These high river stage prospects are particularly significant along the lower Kootenai in Idaho and the lower Columbia.

Streamflow prospects are near average for most of Oregon and for Columbia River tributaries in Washington. More than average flows are expected for the Snake River and its larger tributaries in Idaho. This represents a slight increase over a month ago.

The California Department of Water Resources reports that an exceptionally wet and cold April has further increased the snowpack in the State and generally increased an already excellent water supply outlook. Although releases have been accelerated in major Sierra reservoirs to control anticipated snowmelt, runoff forecasts indicate that all will fill and many will spill before the end of the snowmelt period. For the second consecutive year the local water supply outlook in southern California is excellent.

The above average outlook for the California Central Valley is reflected in streams flowing east of the Sierras in western Nevada.

Streamflow far in excess of average is in prospect for upper Missouri River tributaries, especially in the central Montana area between the Yellowstone and main stem Missouri.

Water supply prospects are near average and adequate for Missouri and Colorado River tributaries in Wyoming. Less than average flows are in prospect for the South Platte in Colorado. If a dry summer should occur, water shortage could be rather severe. Water supply prospects along the Arkansas in Colorado and New Mexico also declined during April to a point where surface supply will be much less than normal demands.

Very limited water will be available along the Rio Grande in New Mexico - a continuation of the pattern since mid-winter. As anticipated, streamflow in Arizona has been deficient but carryover storage is providing an above average surface water supply.

There was a general improvement in water supply outlook in central Utah during April. Except for the Sevier river basin, streamflow prospects are near average. There was heavy snow on the Bear River watershed in northern Utah during April. Streamflow prospects in this area are now well above average.

Inflow to Lake Powell is now forecast at 75 percent of average. Some smaller tributaries to the upper Colorado will have a short late season water supply this year.

Streamflow during the winter months has been below average. Because of below normal temperatures and continuing snow accumulation in the mountains, the trend to below average flow was especially significant in April. It is apparent that the snowmelt will be delayed and flows will remain above that which would be expected from the seasonal snowpack through July and possibly early August.

MISSOURI BASIN

Excessive streamflow is anticipated for the upper Missouri tributaries in western Montana. Near average flows are forecast for the Bighorn and North Platte tributaries in Wyoming. Some degree of surface water shortage may occur on the South Platte in Colorado depending on summer rainfall and water demands.

In Montana, the snowpack in all mountain areas east of the Divide is at or near a maximum of record for the past 30 years. The combination of above average snowfall and below average temperatures increased the water stored in the snowpack at all elevations. Normally, melt occurs at low and medium elevation courses during April. The delay in snowmelt along with the heavy snowpack will produce a large volume of water during the snowmelt season.

SUMMARY OF SNOW WATER EQUIVALENT MEASUREMENTS MAY 1, 1967

MAJOR BASIN AND SUB—WATERSHED	WATER EQUIVALENT IN PERCENT OF: LAST YEAR	AVERAGE
MISSOURI BASIN		
Jefferson	250	170
Madison	250	175
Gallatin	165	145
Missouri Main Stem	190	175
Yellowstone	175	160
Shoshone	240	150
Wind	160	120
North Platte	175	120
South Platte	185	85
ARKANSAS BASIN		
Arkansas	150	75
Canadian	---	---
RIO GRANDE BASIN		
Rio Grande (Colo.)	90	85
Rio Grande abv. Otowi Bridge	60	50
Pecos	---	---
COLORADO BASIN		
Green (Wyo.)	180	130
Yampa - White	200	90
Duchesne	230	125
Price	300	110
Upper Colorado	155	85
Gunnison	130	75
San Juan	85	65
Dolores	70	50
Virgin	135	110
Gila	---	---
Salt	---	---
GREAT BASIN		
Bear	*	271
Logan	*	144
Ogden	*	201
Weber	*	129
Provo - Utah Lake	*	181
Jordan	*	150
Sevier	*	131
Walker - Carson	*	250
Tahoe - Truckee	*	139
Humboldt	*	*
Lake Co. (Oregon)	*	*
Harney Basin (Oregon)	*	275
UPPER COLUMBIA BASIN		
Columbia (Canada)	140	150
Kootenai	165	150
Clark Fork	160	130
Bitterroot	205	123
Flathead	175	140
Spokane	150	116
Okanogan	179	141
Methow	218	136
Chelan	153	117
Wenatchee	195	114

MAJOR BASIN AND SUB—WATERSHED	WATER EQUIVALENT IN PERCENT OF: LAST YEAR	AVERAGE
SNAKE BASIN		
Snake above Jackson, Wyo.	140	120
Snake above Hiese, Idaho	155	135
Snake abv. American Falls Res.	180	160
Henry's Fork	*	250
Southern Idaho Tributaries	240	140
Big and Little Wood	200	140
Boise	160	115
Owyhee	*	*
Payette	175	125
Malheur	*	250
Weiser	185	125
Burnt	*	155
Powder	*	125
Salmon	180	125
Grande Ronde	*	140
Clearwater	150	110
LOWER COLUMBIA BASIN		
Yakima	167	108
Umatilla	*	130
John Day	*	210
Deschutes - Crooked	127	110
Hood	110	95
Willamette	110	100
Lewis	113	122
Cowlitz	---	---
PACIFIC COASTAL BASIN		
Puget Sound	126	111
Olympic Peninsula	130	124
Umpqua - Rogue	160	130
Klamath	240	167
Trinity	155	205
CALIFORNIA CENTRAL VALLEY		
Upper Sacramento	155	180
Feather	285	230
Yuba	*	215
American	*	220
Mokelumne	*	235
Stanislaus	*	220
Tuolumne	*	230
Merced	*	215
San Joaquin	*	240
Kings	*	220
Kaweah	*	220
Tule	*	160
Kern	*	245

Data for California Watersheds supplied by Dept. of Water Resources, and for British Columbia Watersheds by Dept. of Lands, Forests and Water Resources.

* Over 300 percent.

Average is for 1948-62 period. California averages are for 1931-60.

Based on Selected Snow Courses determined by Distribution within the Basin, Length of Record and Repetitive Monthly Measurement Schedules.

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May-September flows of the upper Missouri and main Yellowstone rivers and their tributaries are expected to range near 150 percent of average, two to three times that of last year. Small streams with headwaters in the Belt, Castle and Snowy mountains in central Montana are expected to flow up to twice average in 1967.

The flow of principal streams tributary to the Bighorn River in the Powell basin will be average or better representing an increase in prospects over April 1. A substantial increase in snowpack occurred in the Big Horn mountains in north central Wyoming. Water supply outlook is satisfactory.

The flow of the North Platte into Seminoe reservoir in southeastern Wyoming will be near average. Storage in the major reservoirs on the Platte are down substantially from average. In total, water supply for irrigation is adequate to meet normal demands in southeastern Wyoming and western Nebraska.

Storage and prospective streamflow will provide an above average water supply for irrigated areas near the Black Hills in South Dakota.

For the South Platte basin in Colorado, snowmelt season streamflow is forecast at 75 to 85 percent of average. Valley soil moisture is better than average as a result of April storms in the plains area. Storage for irrigation use is near average and well above average in municipal reservoirs. With normal summer demands, water supplies should be adequate. A dry summer could result in some shortage. There was no material improvement in mountain snowpack during April.

ARKANSAS BASIN

The snowmelt season flow of the main Arkansas River as well as its southern tributaries will be much less than average. Storage is slightly greater than usual but much of the storage is downstream in John Martin Reservoir. The total storage is down substantially from a year ago. Total water supply will be much less than for the past two seasons. The degree of shortage will depend on summer rainfall.

Summer flows of the Canadian and its tributaries in New Mexico will be less than one-half of average. Storage on the Tucumcari project should meet irrigation needs for the area under Conchas reservoir.

RIO GRANDE BASIN

Water supply from the Rio Grande in both Colorado and New Mexico will be among the lowest years of record. The flow into San Luis valley is forecast at about two-thirds of average with less than half of average through New Mexico. Storage is deficient for all reaches of the stream.

In contrast to other areas of the west, the mountain snowpack has disappeared except for the highest elevations along the Continental Divide in Colorado.

COLORADO BASIN

Streamflow prospects declined slightly on the major snowpack watersheds of the upper Colorado River tributaries during April. Tributary forecasts range from near 60 percent of average on the Gunnison, San Juan and Delores to near average on the upper Colorado River near the Continental Divide. Of the tributaries, only the Green River in Wyoming is expected to have flows in excess of average. In Colorado some shortages, especially in late season, can be expected for areas served by the Dolores, tributaries to the Gunnison and other smaller streams with limited or no storage.

Storage and prospective streamflow are expected to provide an average water supply along the Duchesne and Price rivers in central Utah and the Virgin River in the southwest. Water supplies will be extremely short in small streams of southeastern Utah on both sides of the Colorado River.

As with other areas of the west, streamflow has been deficient for over a year.

The forecast of inflow to Lake Powell has been reduced to 75 percent of average, five percent down from April 1.

For the lower Colorado tributaries in Arizona, water supply outlook is good on all projects served by reservoir storage. Irrigated areas depending on direct diversions will be short. The eight major reservoirs serving central Arizona now contain about twice the usual amount of water stored on this date. Releases exceeded inflow by 50,000 acre-feet in April. Storage in Salt River reservoirs is now 75 percent of capacity.

Precipitation and streamflow has been far below average on most watersheds. A mid-month storm on the Verde watershed resulted in a slight increase in flow.

GREAT BASIN

April was cold and wet over most of the interior basin in Utah, Nevada and Oregon. Except for some areas along the Sevier River and tributaries in Utah, water supplies will be at least satisfactory. In northern Utah, April increases in snowpack increased streamflow forecasts up to

SELECTED STREAMFLOW FORECASTS MAY - SEPTEMBER as of MAY 1, 1967

STREAM AND STATION	1000 ACRE-FEET		PERCENT OF AVERAGE
	FLOW	FORECAST	
UPPER MISSOURI	1966	1967	1967
Jefferson at Sappington, Montana	198	1030	125
Madison near Grayling, Montana 1/	319	470	129
Gallatin near Gateway, Montana	359	618	148
Missouri near Zortman, Montana 2/	2254	5060	130
Sun at Gibson Dam, Montana 3/	406	690	120
Marias near Shelby, Montana 4/	358	690	122
Milk near Eastern Crossing, Montana	230	210	102
Yellowstone at Livingston, Montana	1521	2525	125
Shields at Clyde Park, Montana	54	135	164
Clark Fork at Chance, Montana	412	690	123
Shoshone, Inflow to Buffalo Bill Res., Wyo.*	577	870	108
Wind at Dubois, Wyoming *	80	97	97
Bull Lake near Lenore, Wyoming *	132	204	115
Tensleep near Tensleep, Wyoming*	52	75	104
Yellowstone at Miles City, Montana 5/	3169	6700	126
Missouri near Williston, N. Dakota 6/		12000	129
Inflow to Yellowtail Res., Montana	569	1600	110
PLATTE			
North Platte at Saratoga, Wyoming *		715	112
Laramie near Jelm, Wyoming 7/*		121	108
Clear at Golden, Colorado *		120	90
St. Vrain at Lyons, Colorado *		65	82
Cache LaPoudre near Fort Collins, Colorado 8/ *		180	73
ARKANSAS			
Arkansas at Salida, Colorado 9/ *		225	58
Purgatoire at Trinidad, Colorado *		17	38
RIO GRANDE			
Rio Grande near Del Norte, Colorado 10/ *		275	56
Conejos near Mogote, Colorado 11/ *		130	66
Rio Chama near LaPuente, New Mexico *		100	47
Rio Grande at Otowi Bridge, New Mexico 12/(Mar-July)		250	41
Pecos at Pecos, New Mexico **		20	38
UPPER COLORADO			
Colorado near Granby, Colorado 13/ *		240	103
Colorado near Glenwood Springs, Colorado 14/*		1325	87
Roaring Fork at Glenwood Springs, Colorado 15/ *		625	82
Gunnison at Grand Junction, Colorado *		750	58
Dolores at Dolores, Colorado		150	58
Colorado near Cisco, Utah		2610	79
Green below Flaming Gorge Res., Utah 16/		1140	101
Yampa at Steamboat Springs, Colorado *		225	78
White at Meeker, Colorado *		250	75
Duchesne near Tabiona, Utah 17/ (M-July)		115	111
Rock Creek near Mountain Home, Utah		105	107
Price near Scofield, Utah 18/		33	103
Green at Green River, Utah 16/		2680	92
San Juan near Rosa, New Mexico *		360	60
Animas at Durango, Colorado *		280	61
San Juan near Bluff, Utah 19/		520	54
Colorado, Inflow to Lake Powell, Arizona 20/(May-July)		5800	75
LOWER COLORADO			
Gila near Solomon, Arizona (Apr-May)	79	8	40
Salt at Intake, Arizona (Apr-May)	283	33	23
Verde above Horseshoe Dam, Arizona (Apr-May)	27	19	40

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SELECTED STREAMFLOW FORECASTS MAY - SEPTEMBER as of MAY 1, 1967

STREAM AND STATION	1000 ACRE-FEET		PERCENT OF AVERAGE
	FLOW	FORECAST	
GREAT BASIN	1966	1967	1967
Bear at Harer, Idaho		350	173
Logan near Logan, Utah 21/		134	115
Ogden, Inflow to Pine View Res., Utah 22/**		88	122
Weber near Oakley, Utah		135	119
Inflow to Utah Lake, Utah		215	105
Big Cottonwood near Salt Lake City, Utah		41	117
Beaver near Beaver, Utah		18	83
South Fork Humboldt near Elko, Nevada (May-July)		42	85
Humboldt at Palisades, Nevada (May-July)		93	74
Truckee at Farad, California 25/ (May-July)		450	237
East Carson near Gardnerville, Nevada (May-July)		270	189
West Walker near Coleville, California		230	187
UPPER COLUMBIA			
Columbia at Revelstoke, British Columbia	8172	23000	118
Kootenai at Wardner, British Columbia		6300	137
Kootenai at Leonia, Idaho	8172	10950	130
Flathead near Columbia Falls, Montana 26/	4955	7760	133
Flathead near Polson, Montana 26/	5949	9310	134
Clark Fork above Missoula, Montana	961	1990	124
Bitterroot near Darby, Montana	232	550	106
Clark Fork at Whitehorse Rapids, Montana 26/	9516	15460	123
Columbia at Birchbank, British Columbia 26/		53400	126
Spokane at Post Falls, Idaho 27/		2600	115
Columbia at Grand Coulee, Washington 26/		79200	126
Okanogan near Tonasket, Washington		1900	105
Chelan at Chelan, Washington 28/		1420	116
Wenatchee at Peshastin, Washington		1870	110
SNAKE			
Snake above Palisades Res., Wyoming 29/*		2710	104
Snake near Heise, Idaho 29/		3700	106
Henry's Fork near Rexburg, Idaho 30/		1225	110
Big Lost near Mackay, Idaho 31/		210	147
Big Wood, Inflow to Magic Res., Idaho 32/		200	123
Bruneau near Hot Springs, Idaho		165	110
Owyhee Res., Net Inflow, Oregon	47	175	95
Boise near Boise, Idaho 33/		1400	112
Malheur near Drewsey, Oregon		42	120
Payette near Horseshoe Bend, Idaho 34/		1800	114
Snake at Weiser, Idaho		4250	80
Salmon at Whitebird, Idaho		7500	121
Clearwater at Spalding, Idaho		8800	122
LOWER COLUMBIA			
Grande Ronde at LaGrande, Oregon		110	91
Yakima at Cle Elum, Washington 35/		890	104
Deschutes at Benham Falls, Oregon 36/		430	79
Columbia at The Dalles, Oregon 26/		114000	120
Hood near Hood River, Oregon 36/		250	90
Willamette at Salem, Oregon 36/*		4950	89
Lewis at Ariel, Washington 37/		1220	119
Cowlitz at Castle Rock, Washington		2500	112
NORTH PACIFIC COASTAL			
Dungeness near Sequim, Washington		168	106
Rogue at Raygold, Oregon	523	737	101
Klamath Lake, Net Inflow, Oregon	345	549	125

SELECTED STREAMFLOW FORECASTS MAY - SEPTEMBER as of MAY 1, 1967

STREAM AND STATION	1000 ACRE-FEET		PERCENT OF AVERAGE
	FLOW	FORECAST	
CALIFORNIA CENTRAL VALLEY 38/**	1966	1967	1967
Sacramento, Inflow to Shasta, California	1598	2500	140
Feather near Oroville, California	1324	3000	154
Yuba at Smartville, California	770	1700	151
American, Inflow to Folsom Res., Calif.	761	2300	166
Cosumnes at Michigan Bar, California	54	275	210
Mokelumne, Inflow to Pardee Res., Calif.	286	805	168
Stanislaus, Inflow to Melones Res., Calif.	463	1230	167
Tuolumne, Inflow to Don Pedro Res., Calif.	767	2060	170
Merced, Inflow to Exchequer Res., Calif.	387	1120	180
San Joaquin, Inflow to Millerton Lake, Calif.	837	2440	201
Kings, Inflow to Pine Flat Res., California	825	2240	191
Kaweah, Inflow to Terminus Res., California	149	610	232
Tule, Inflow to Success Res., California	13	150	268
Kern, near Bakersfield, California	220	910	210

Forecasts in California provided by Department of Water Resources.
Average is for 1948-62 period except California. California is computed for 1911-60
Forecasts assume average Effective Climate Conditions from Date Through Snow Melt Season.

Explanatory Notes on Forecasts listed on Inside Back Cover.
** April - September Period ** April - July Period*

125 percent of average or more for the Bear, Weber, Ogden, Provo and Jordan rivers and their tributaries. Storage in larger irrigation reservoirs is slightly above average for the state, exclusive of Colorado River storage.

The highest flows for fifteen years are anticipated from the east slope of Sierra streams in western Nevada. With cool weather and almost continuous storms during April, snowpack is at a maximum of record for many snow courses for May 1. Storage in irrigation reservoirs is greater than average. Watershed soils are well primed.

Water supply prospects for the Humboldt in Nevada and areas of southern Oregon improved during March to near average.

COLUMBIA BASIN

A heavy, near record to record snowpack in British Columbia, Montana and northern Idaho is expected to produce May-September streamflow on the Columbia River main stem, Kootenai and Flathead which will be among the highest of recent record. Cold April temperatures coupled with above average precipitation in most portions of the Basin has retarded snowmelt. As a result the April streamflow was much below average.

The Columbia at The Dalles is forecast to flow 114,000,000 acre-feet during May-September. This is third highest in the past 30 years of record exceeded only by 1948 and 1956.

The delayed snowmelt and the volume of streamflow to come indicate high peak flows can be expected unless the sequence of future temperatures and precipitation are extremely favorable. This sequence would have to be made up of moderate temperature periods interspersed with cool rainless periods such as occurred in 1954 and 1956.

The Water Resources Service of the Province of British Columbia reports that the snowpack on the watersheds of all rivers of the Province and at all elevations is at near maximum to maximum for the May 1 period of record.

Streamflow volume forecasts for the runoff period May through September for British Columbia snow-fed rivers call for volumes comparable to the highest of record. River stages will be dependent on the melt pattern of May and June. If a prolonged hot spell were to occur, rivers can rise to flood stages; however, if the melt pattern is such that continued runoff occurs, the resultant maximum stages would not be excessive.

The Water Resources Service points out that in 1964 on the Fraser River Basin and 1954 on the Columbia River Basin May 1 mountain snowpacks were comparable to the current year. In both those years the melt was such that although higher than usual, stages were not of flood proportion.

In western Montana the snowpack is generally highest to second highest of record in the Flathead, Kootenai, and portions of the upper Clark Fork River drainages. Cool temperatures and good mountain snowfall during April combined to increase the amount of water stored in the snowpack even at the lower elevations.

Streamflow for the May-September period is forecast third largest to the largest volume in the last 30 years on streams in the Kootenai and Flathead River drainages. Upper Clark Fork drainages should produce 110 to 130 percent of average amounts.

On streams without adequate reservoir regulation, streamflow will be high for long periods of time as the large snowpack melts. A combination of warm temperatures and above average rainfall will cause many streams to leave their banks.

Snowfall in Idaho during the month of April was unusually heavy. Water content of the snowpack continued to increase on practically all snow courses when it would ordinarily be melting. These storms were welcome to the areas south of the Snake River facing drought conditions, but have added to the problem inherent in the record-breaking snowpack on the Kootenai River in northern Idaho. Temperatures during the month were also at record lows throughout the state which reduced streamflow far below normal. This poses a special problem on rivers with a high water potential because more water will now have to come down in considerably less time.

The melting of the record-breaking snowpack on the Kootenai River as interpreted by the River Forecast Center of the Weather Bureau will produce a probable flood stage of between 34 and 37 feet at Bonners Ferry. This is among the highest years of record. Their interpretation is that a flood potential also exists on the Big Lost, Little Wood and Little Salmon rivers.

Soil moisture conditions at high elevations have not changed because the major snowmelt of the season has not yet started. Unusually dry soil remains beneath the heavy snowpack.

Reservoir stored water throughout Idaho is generally well below normal. On many rivers, stored water was used for the entire month of April because irrigation demands were up and inflow to the reservoirs was below this demand.

The water supply outlook for Columbia River tributary streams in Washington has improved considerably over the good rating of a month ago. Streamflow during April was well below normal on all the major streams. Temperatures were below normal. Precipitation ranged from below normal in the Pend Oreille-Spokane drainage to 120-140 percent above normal in central Washington. All reservoirs have considerably less water in storage on May 1 than average for this time of year. The power reservoirs, for example, F. D. Roosevelt Lake and Lake Chelan, have considerably less water in storage but these reservoirs have all been lowered for flood control purposes. With the expected runoff all reservoirs should fill and most will spill during the runoff period.

Low flows during April, generally above normal precipitation and well above normal snow water equivalents result in forecasted flows for the May-September period well above normal and well above that which was reported last month. Forecasts now range from 85 percent of normal for Ahtanum Creek as measured near Tampico to a high of 126 percent for the Columbia River as measured at Birchbank.

Most farmers, ranchers and other water users in Oregon will have average water supplies this summer. Some areas in the north central part of the state will have below average water conditions. However, stored water supplies in the state are satisfactory in most cases and soil moisture conditions are excellent.

Colder than usual temperatures, combined with the heavy precipitation during the month, produced a snowpack considerably above average for May 1. Heaviest snowpacks for May 1 exist along the southern tier of counties in the state, while the lowest are located in the Hood River and Mile Creeks area near The Dalles.

Soil moisture in the upper watersheds under the snowpack is excellent. Only a small part of the snowmelt will be absorbed by the soil mantle as runoff begins.

ALASKA

Cool weather during the month of April has caused a delay in snowmelt at the lower elevations throughout the state. Greater than normal snow cover exists in nearly all areas where snow surveys were made as of May 1.

The Tanana, Chena, and portions of the upper Yukon have an unusually heavy snow cover. April storms added substantial amounts to the high elevation snowpack. Warm temperatures in May could cause a rapid snowmelt, but generally dry soils in the region are expected to reduce the runoff. The late season deep snow has resulted in a high winter kill of moose in the Susitna Valley.

Heavy snow cover exists in the Snettisham watershed in southeast Alaska near Juneau.

CALIFORNIA

The California Department of Water Resources, coordinating agency for snow surveys in California, reports that the magnitude of the May 1

STORAGE IN LARGE RESERVOIRS MAY 1, 1967

BASIN AND NAME OF RESERVOIR	CAPACITY (1000 A.F.)	STORAGE (1000 A.F.)
UPPER MISSOURI		
Boysen	560	253
Buffalo Bill	380	92
Canyon Ferry	2043	1026
Hebgen	377	221
Tiber	1316	437
Belle Fourche	185	140
Keyhole	190	129
Fort Peck	19410	
Fort Randall	5800	3907
Garrison	24500	17008
Oahe	23600	16071
Big Bend	1900	1724
PLATTE		
Glendo	786	455
Pathfinder	1011	226
Seminoe	982	76
City of Denver (6)	578	398
Colo-Big Thompson (4)	865	307
ARKANSAS		
Conchas	280	164
John Martin	367	137
RIO GRANDE		
Elephant Butte	2207	223
El Vado	194	14
UPPER COLORADO		
Flaming Gorge	3789	2155
Navajo	1709	381
Powell	28040	7066
Blue Mesa		376
LOWER COLORADO		
Havusu	619	595
Mead	27207	14530
Mohave	1810	1674
San Carlos	1206	256
Salt River Res. (4)	1755	1400
Verde River Res. (2)	323	162
GREAT BASIN		
Bear	1421	1146
Lahontan	286	241
Rye Patch	179	94
Sevier Bridge	236	82
Strawberry	265	105
Tahoe	732	559
Utah	1149	709

BASIN AND NAME OF RESERVOIR	CAPACITY (1000 A.F.)	STORAGE (1000 A.F.)
UPPER COLUMBIA		
Chelan	676	42
Coeur d'Alene	238	172
Flathead	1791	816
Hungry Horse	2982	1333
Kootenay	673	210
Pend Oreille	1155	793
Roosevelt	5232	899
LOWER COLUMBIA		
Cougar	155	74
Detroit	300	181
Hills Creek	200	116
Lookout Point	337	196
Yakima Res. (5)	1066	715
SNAKE		
American Falls	1700	1598
Arrowrock	287	206
Anderson Ranch	423	191
Brownlee	980	339
Cascade	653	186
Jackson	847	493
Lucky Peak	278	39
Palisades	1202	708
Owyhee	715	458
PACIFIC COASTAL		
Cachuma	205	206
Casitas	254	130
Clair Engle	2500	2220
Clear Lake	440	239
Nacimiento	350	345
Ross	1203	733
Upper Klamath	584	544
CALIFORNIA CENTRAL VALLEY		
Almanor	1036	743
Berryessa	1602	1626
Camanche	432	312
Don Pedro	290	173
Folson	1010	661
Hetch-Hetchy	360	70
Isabella	570	295
McClure	1026	767
Millerton	521	468
Pine Flat	1013	846
Shasta	4500	4467

Reservoir Storage Data Provided by Bureau of Reclamation, Corps of Engineers, Geological Survey, and water using organizations. Data from California and British Columbia provided by Department of Water Resources and Department of Lands, Forests and Water Resources, respectively.

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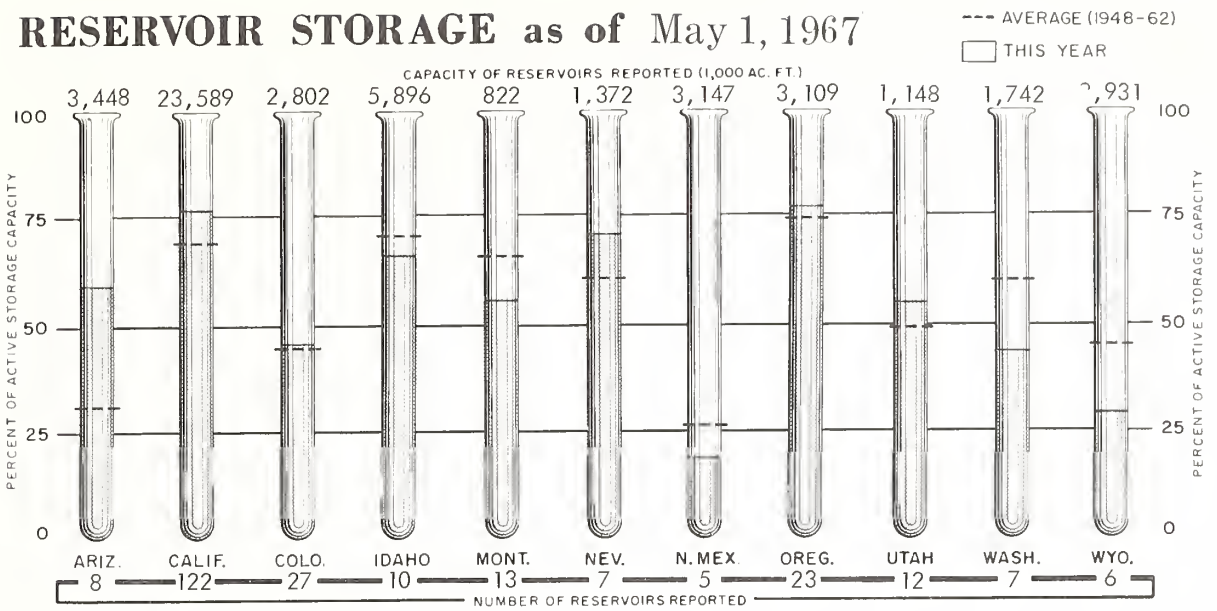
RESERVOIR STORAGE as of May 1, 1967



snowpack in the Sierra-Nevada and Cascade Range assures a spring runoff that will exceed records and may pose a flood threat in the coming months. Only in the extreme wet years of 1938, 1952 and 1958 have comparable snowpack conditions been measured. In the southern Sierras, the snowpack is the greatest measured since the beginning of the California Snow Survey program which dates back to 1929. The snow stored water in California on May 1 was about 175 percent of that normally in the pack on April 1 when its assumed maximum snowpack accumulation usually occurs.

Because of potential flooding from the record breaking late season snowpack, Federal, State and local agencies are coordinating and preparing for the anticipated snowmelt runoff. Consequently, regulated tributaries to the San Joaquin Valley are carrying high downstream flow as the result of controlled reservoir releases. These releases are being made to create or conserve space for anticipated snowmelt runoff. It should be noted that any serious snowmelt flooding would require the presence of a persistent unseasonally high temperature regime in Sierra watersheds.

However, last month's temperature pattern offers hope that serious problems will not develop. California experienced one of the coldest Aprils of record, with temperatures for the month ranging from 10 to 20 degrees below normal maximums. It was also one of the wettest Aprils. In a number of areas all previous records for the month were broken. Even in southern California, April precipitation was abundant ranging from 230 percent of normal in San Diego to over 300 percent of normal in Los Angeles. The firmly entrenched deep trough off the Pacific Coast that ushered in the March storms persisted during most of April producing almost continuous precipitation. This was replaced the latter part of the month by a migrating pattern of troughs and ridges which produced several general storms. Except for the southern desert area, precipitation during April ranged from normal to over 400 percent of normal. The precipitation in California statewide for the October-April period was 130 percent of normal.

All forecasts for April-July runoff for California snowmelt streams are well above those reported one month ago. Snowmelt runoff from Sierra ranges is now forecasted to range from 150 to over 250 percent of normal. As a result of the late snowpack and below normal temperatures during April the usual snowmelt runoff has been held back. Consequently with normal temperature regimes the remainder of the season summer flows promise to be the greatest of record.

Runoff of California streams during April generall reflected the month's wet, cold conditions averaging about 125 percent of normal for this date. The flow of snow-fed streams was mostly below or near normal for the month while low elevation drainages were well above normal and more accurately reflects the heavy precipitation. Streamflow from the Sacramento and San Joaquin Valley tributaries averaged 100 to 110 percent of normal respectively.

Reservoirs in California gained about 800,000 acre-feet of storage during April and on May 1 held 110 percent of average for this date. The necessity for main flood control reservation to control forthcoming snowmelt placed a limitation on increase in storage especially on tributaries to the San Joaquin Valley.

EXPLANATION of STREAMFLOW FORECASTS

All flows are observed flows except as adjusted for: 1/ Change in storage in Hebgen Lake. 2/ Change in storage in Canyon Ferry and Tiber reservoirs. 3/ Change in storage in Gibson Reservoir and measured diversions. 4/ Change in storage in Two Medicine, Four Horns and Lake Francis reservoirs. 5/ Change in storage in Boysen and Buffalo Bill reservoirs.

6/ Change in storage in Boysen, Buffalo Bill, Canyon Ferry, Tiber, and Fort Peck reservoirs. 7/ Plus diversions to Cache la Poudre. 8/ Minus diversions from North Platte, Laramie, and Colorado rivers plus measured diversions above station. 9/ Change in storage in Twin Lakes and Sugar Loaf reservoirs minus diversions from Colorado River.

10/ Change in storage in Rio Grande, Santa Maria, and Continental reservoirs. 11/ Change in storage in Platoro Reservoir. 12/ Change in storage in El Vado Reservoir. 13/ Change in storage in Granby Reservoir plus diversions to Cache la Poudre and through Adams Tunnel. 14/ Changes as indicated in (13) plus Moffatt Tunnel diversion. 15/ Plus diversions to Arkansas River.

16/ Change in storage in Flaming Gorge and Big Sandy reservoirs. 17/ Plus diversion through Duchesne Tunnel. 18/ Change in storage in Scofield Reservoir. 19/ Change in storage in Navajo Reservoir. 20/ (Lee's Ferry) Change in storage in Flaming Gorge, Navajo, Lake Powell, and Big Sandy reservoirs.

21/ Plus Utah Power and Light Company tailrace and Logan, Hyde Park, and Smithfield canals. 22/ (Inflow record computed by U. S. Bureau of Reclamation.) 23/ Plus diversion by Weber-Provo Canal and change in storage in Wanship Reservoir. 24/ Change in storage in Deer Creek Reservoir, minus diversions through Duchesne Tunnel and Weber-Provo Canal, plus diversion through Salt Lake City Aqueduct. 25/ Change of storage in Lake Tahoe and Boca Reservoir. (Forecast by Truckee Basin Committee)

26/ Change in storage in any of these reservoirs above the station: Kootenai Lake, Hungry Horse, Flathead Lake, Pend Oreille Lake, F. D. Roosevelt Lake, Lake Chelan, Coeur d'Alene Lake, Brownlee and Noxon; and pumpage at Roosevelt Lake. 27/ Changes in storage in Coeur d'Alene Lake and diversions by Spokane Valley Farms Company and Rathdrum Prairie canals. 28/ Change in storage in Lake Chelan. 29/ Changes in storage for Jackson Lake and Palisades Reservoir above stations. 30/ Change in storage in Henry's Lake, Island Park and Grassy Lake reservoirs and diversions between Ashton and Rexburg.

31/ Change in storage in Mackay Reservoir, and diversion in Sharp Ditch. 32/ (Combined flow Big Wood River nr. Bellevue and Camas Creek nr. Blaine.) 33/ Change in storage in Arrowrock, Anderson Ranch, and Lucky Peak. 34/ Change in storage in Cascade and Deadwood reservoirs. 35/ Change in storage in Keechelus, Kachess, and Cle Elum reservoirs plus diversion by Kittitas Canal. 36/ (Corrected to natural flow). 37/ Change in storage in Merwin, Yale, and Swift reservoirs. 38/ (Corrected for upstream impairments).

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